A Morphological and Chemical Study of Carbonate Globules Contained Within Mantle Xenoliths of the Sverrefjell Volcano Spitsbergen

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Previous studies have shown that carbonate globules contained within carbonate cemented breccia associated with the Sverrefjell volcano are similar to those found in the ALH84001 meteorite. Previous studies have also documented the occurrence of populations of carbonate globules within olivine rich mantle xenoliths from the same area. We have applied a number of analytical instruments to documenting the mineralogy and morphology of these mantle xenolith samples in an attempt to understand further the conditions of formation of these structures and how they relate to previous carbonate globules studied from this site and the carbonate globules found in ALH84001.
An interesting observation from this data is the detection of hematite and magnetite within distinct zones of the carbonate globules and the occurrence of carbon in conjunction with magnetite. This is predicted from studies on the stability fields of hematite, magnetite, siderite, and graphite at 1 bar CO_2 pressure over a range of temperatures and oxygen fugacities. Interestingly, the composition of the carbonate globules seem to follow the trends alluded to during research conducted on thermal decomposition of siderite and production of magnetite and polyaromatic hydrocarbons as a mechanism to explain the presence of PAHs and magnetite in ALH84001. However in these samples no secondary shock can have occurred to influence formation of these compounds. Therefore we are left with the possibility that the carbon and magnetite formed during the precipitation of carbonate from a CO_2 rich hydrothermal fluid percolating the olivine xenoliths.